STORAGE BATTERY SYSTEMS, LLC.

INSTALLATION, OPERATING & MAINTENANCE INSTRUCTIONS

For Valve Regulated Lead Acid Batteries used in Stationary Applications

Commissioning by: ..... **Date: .....**

Number of cells/blocks: ..... **Model #: .....**

SAFETY PRECAUTIONS & WARNINGS

	Familiarize personnel with battery installation, charging and maintenance procedures. Display operating instructions visibly near the battery system. Restrict access to battery area, permitting trained personnel only, to reduce the possibility of injury.
	Wear rubber apron, gloves and safety goggles (or face shield) when handling, installing, or working on batteries. This will help prevent injury due to splashing or spillage of sulfuric acid. Observe all accident prevention rules.
	Prohibit smoking. Keep flames and sparks of all kinds away from the vicinity of storage batteries as liberated or entrapped hydrogen gas in the cells may be exploded, causing injury to personnel and/or damage to cells.
	Wash all acid splashes in eyes or on skin with plenty of clean water and seek immediate medical assistance. Acid splashes on clothing should be washed out with water. Acid on skin or clothing should also be immediately neutralized with a solution of baking soda and water.
	Explosion and fire risk. Avoid short circuits. Never place metal tools on top of cells, since sparks due to shorting across cell terminals may result in an explosion of hydrogen gas in or near the cells. Insulate tool handles to protect against shorting. Prior to making contact with the cell, discharge static electricity by touching a grounded surface.
	Electrolyte is highly corrosive. Promptly neutralize and remove any electrolyte spilled when handling or installing cells. Use a baking soda/water solution (1 lb. per gallon of water) to prevent possible injury to personnel.
	Batteries are extremely heavy. Exercise care when handling batteries. When lifting use appropriate mechanical equipment to safely handle batteries and avoid injury to personnel.
	Dangerous voltage. Whenever possible, when making repairs to charging equipment and/or batteries, interrupt AC & DC circuits to reduce the possibility of injury to personnel and damage to system equipment. This is particularly import with high voltage systems (110 volts and above).
	Recycle and Dispose of Used Batteries Used batteries contain valuable recyclable materials. They must NOT be disposed of with domestic waste. Modes of return and recycling shall conform to the prevailing regulations in operation at the site where the battery system is located. Call SBS for recycling options.

Version: 2015-March 1st

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Warranty Note

Any of the following actions will invalidate the warranty:

- Non-adherence to the Installation, Operating and Maintenance Instructions
- Repairs carried out with non-approved spare parts or by non-approved personnel
- Unauthorized interference with the battery
- Mixing different types and/or ages of batteries without obtaining SBS's approval
- Operating the batteries above 95°F

Any and all problems or abnormalities must be reported to SBS within 30 days of detection. This includes voltage and/or internal resistance readings that are outside the limits in this manual and are not improving when corrective action is applied. Failure to report ANY problems in a timely manner often leads to permanent damage to the battery and the warranty will be void.

1.0 DELIVERY AND STORAGE

Delivery

Unpack the shipment as soon as it is delivered.

Verify that all of the equipment has been delivered and in good condition. Check quantities against packing slip and accessories list. If there is any damaged or missing product, immediately notify the trucking company as well as SBS.

If necessary, clean all parts before assembling.

Storage

Fully charged 2V cells have an open circuit voltage of 2.14V +/-.02V; 6V blocks average 6.42V +/- .06V; 12V blocks average 12.84V +/- .12V at 77°F.

Store the batteries in a dry, clean and preferably cool and frost-free location. Do not expose the cells to direct sunlight as damage to the container and cover may occur.

VRLA batteries are supplied fully charged, storage time is limited to a maximum of 6 months without recharge. The self discharge of a fully charged VRLA battery is around 2% per month at 77°F. In order to easily charge the batteries after prolonged storage, it is advised not to store batteries for more than:

- 6 months at 50°F
- 3 months at 68°F
- 2 months at 86°F

An equalizing (refreshing) charge shall be carried out according to charging section 3.0 after this time or if the average open cell voltage drops below 2.10 volts per cell. Alternatively cells can be float charged during storage.

►**Note:** Failure to observe these conditions may result in reduced capacity and service life as well as voiding the battery warranty.

Storage of a Battery After Use

Never store a discharged battery. Ensure it is completely charged before storage. Storage times shown above (before use) also apply after use.

2.0 INSTALLATION

The electrical protective measures, accommodation and ventilation of the battery installation must be in accordance with the applicable rules and regulations. This includes layout, safety equipment and warning signs required.

Ventilation

Valve Regulated Lead-acid batteries do produce hydrogen and oxygen during operation. This is especially true during charging and discharging. These gases result from electrolysis of the water portion of the electrolyte by the charging current. Natural or artificial ventilation is recommended in the battery room, or area, to prevent build-up. Concentrations above 4% can result in an explosive mixture, which could be ignited by sparks from adjacent electrical equipment as well as sparks or open flame introduced by personnel. All air moved by ventilation should be exhausted into the outside atmosphere and should not be allowed to re-circulate into other confined areas. Ventilation requirements vary.Contact your local authority for requirements.

Location

A battery system should be installed in a clean, cool and dry location. Avoid placing the battery in a warm area or in direct sunlight. Heaters, radiators and steam pipes can cause serious electrolyte temperature variation among cells within a battery system. The layout and contents of a battery room must comply with all local standards and allow easy access to the batteries.

Handling

Valve regulated lead-acid batteries are supplied in a fully charged state and must be unpacked carefully to avoid short circuit between terminals of opposite polarity. The cells are heavy and must be lifted with appropriate equipment. Avoid lifting batteries by the terminal posts. Batteries should be lifted from bottom of jars or with available lifting straps. At all times exercise caution when handling batteries to prevent damage of the plastic containers and covers. Contact SBS if you are interested in purchasing lifting straps or handling equipment.

Tools

Use tools with insulated handles. Do not place or drop metal objects onto the battery. Remove rings, wristwatch, and metal articles of clothing which may come into contact with the battery terminals.

Removal

Before removing old batteries, ensure that all electric loads are switched off (breakers, fuses, and switches). This must be carried out by a qualified professional. Batteries must be packaged, shipped and recycled per regulations.

Rack Installation

Choose location to install rack and ensure that the area is clean and level.

Assemble rack according to instructions supplied. If instructions are missing, contact rack supplier.

Set rack in final resting place. If mounting to the floor, mark and then drill anchor holes. Install contractor-supplied anchor bolts and tighten.

Spill Containment Installation

If an SBS spill containment system is supplied the rack will be installed inside the polypropylene spill pans. Polypropylene is acid resistant, extremely strong and can support up to 15,000 lbs. per square inch without degradation of the material. SBS supplies different size spill pans that are butted together in different combinations to form different spill containment system lengths and widths. Flexible connectors are supplied to 'connect' the pans together.

If the rack and spill containment is to be anchored to the floor you will follow the previous rack installation instructions; however, you must also assemble and place the spill containment system under the rack before marking the anchor holes. After the anchor holes are marked, drill through the pans and then drill into the floor. Insert anchor bolts and tighten.

Where needed, caulk hole/bolt with silicon to provide a 100% leak proof spill containment system.

After rack and spill containment system are installed, ensure all bolts are tight and properly torqued.

Optional acid absorbing/neutralizing pillows can be placed in the spill pans after the battery installation is complete.

Installation of Cells/Batteries

Begin installing the batteries on the lower step or tier for stability and safety reasons.

Recommended spacing between the cells is ¼ to ½" however spacing is not required.

Talcum Powder may be used on the platform surface or rails to ease movement. **DO NOT USE** any other type of lubricant such as Grease or Oil as they may contain mineral spirits which can damage the jar materials.

Make sure to arrange batteries plumb and level with the correct polarity – see series vs. parallel connection for explanation. Carefully follow the polarity sequence to avoid short circuiting cell groups.

Series Connection – batteries are usually installed in series.

Place the batteries on the rack making sure that the positive terminal of one battery is connected to the negative terminal of the next battery and continue in the same fashion. Make sure batteries are aligned properly.

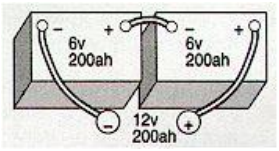


Figure 1: These are two 6V batteries in series to produce 12V. You can add more batteries for a higher voltage, i.e. 24, 48, 130Vdc.

Parallel Connection – Batteries may be connected in parallel to give higher current capability. In the case of parallel connected strings, use only batteries of the same capacity, design, and age, with a maximum of four parallel strings. The resistance of the cables in each string must be the same, e.g. same cross section, same length.

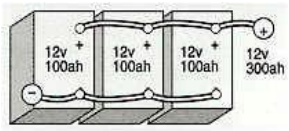
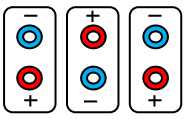
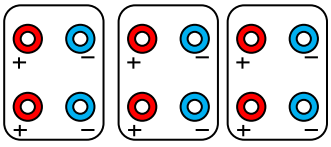


Figure 2: These are three 12V 100Ah batteries in parallel. They produce 12V with 3X the capacity (300Ah) of a single battery.

2V cells should be aligned per the following arrangements or as intercell connectors dictate.

Single post cells 

Two post cells 

Check that all contact surfaces are clean and corrosion free. If required, clean with brass wire brush.

Apply a thin coat (use sparingly) of No-Ox grease to terminals, on bolt threads, and other exposed metal surfaces. Be careful to avoid contact with the cover and container

Tighten the terminal screws with an insulated torque wrench in accordance with Table 1 below.
Fit inter-step, row, or tier connector (jumper) cables – observe the same torque values noted in Table 1.
A loose connection can make adjusting the charger difficult, create erratic performance, and lead to possible damage to the battery and/or even personal injury.

After all bolts are properly torqued, fit any insulating covers/boots supplied for protection against inadvertent contact.
Number the cells for maintenance purposes, starting from the positive end terminal to the negative end terminal.

Table 1 – Torque Loadings for Terminal Screws

Battery Type	Terminal Bolt	Torque Range		
		Inch Pounds	Foot Pounds	Nm
AGM100 - 150	M6	90	7.5	10.1
AGM200 - 3000	M8	130	10.8	14.7
Eos–AGM100 - 3000	M8	130	10.8	14.7
GGM100 - 150	M6	90	7.5	10.1
GGM200 - 3000	M8	130	10.8	14.7
VRZ100 - 3000	M8	130	10.8	14.7
AFT/GFT-All	M6	65	5.4	7.3
S-Series • 12v: S-12180 - S-12900 • 6v: S-6V195	M6	65	5.4	7.3
S-Series • 12v: S-12V120+ • 6v: S-6V220 - S-6V225	M8	130	10.8	14.7
G-Series • G12400 - G-12900	M6	65	5.4	7.3
G-Series • G-12V100 – G-12V210	M8	130	10.8	14.7

**Contact SBS if you have terminal bolt discrepancies or if your batteries are not listed above.*

Charger Connection

Before charger is connected, make sure the cells are clean and double check all connections for correct torque (Table 1) and polarity.

Measure the total voltage of the battery string at the end battery terminals. The voltage should be equal to the number of cells (batteries) times the voltage of one of the cells (batteries).

Example: 60 cells times a standard open circuit voltage of 2.14Vpc = 128.48Vdc.

Finally, with the charger switched off, the battery fuse removed, and the load disconnected, connect the battery to the DC power supply. Ensure that the polarity is correct – positive terminal of the battery to the positive terminal of the charger.

Switch on the charger (per charger instructions) and adjust the float and equalize voltages as needed. Charge according to charging instructions 3.0.

►**Note:** After the Initial Charge, record all of the data specified under the Required Periodic Inspection and Maintenance Activities Annual Battery System Checks (including monthly and quarterly data), and save the data. Documentation of maintenance activities will be required in case of warranty claim or problems with the battery system.

3.0 CHARGING

Charging Current

Limitation of the charging current is not required under floating condition. During the initial or an equalizing charge, the current should be limited to 20% of the Ah rating of the battery.
Example: AGM2V100 = 100Ah, maximum charge current should be .20 x 100 = 20Amps.

Ripple Current

In the standby operation mode, the effective value of the AC ripple current must not exceed 5A per 100Ah @ 8Hr. Otherwise, reduced operational life as well as increased maintenance should be expected. Charging current must be filtered so that the battery system will have maximum life and minimum maintenance during its life. You should never operate an unfiltered charger with VRLA batteries. Doing so will shorten the life of the batteries and void the warranty.

Initial Charge (Commissioning Charge)

Before initial charge, all batteries must be inspected for physical/mechanical damage.

Charge at a voltage of 2.35Vpc for no more than 24 hours. The fully charged condition has been achieved when, for a period of two hours, the cell voltages do not continue to increase and the charging current does not continue to decrease.

Upon completion of the initial charge place the batteries on float charge.

Batteries are shipped from SBS at approximately 90-100% capacity and will attain 100% capacity after 1-6 months on float charge.

Record Initial Reference Values

After the initial charging of the battery, measure all of the cell internal resistance values and voltages using a battery internal resistance tester. Ensure all battery to battery, battery to terminal connections, as well as inter-tier and load connections have appropriate resistances. Record all of these initial values for comparison over the life of the battery system. In addition, the following data should be documented for Initial charging records:

- Date and time of the completion of the Initial Charge on the battery system
- Float Voltage of the DC output of the charger as measured on the main (+) and (-) terminals of the battery.
- Float Current of the DC output of the charger measured on the cable(s) to the positive post of the battery.
- Float AC ripple voltage and current as measured on the main (+) and (-) terminals of the battery.
- Battery temperature (at negative post) and ambient temperature.

Float Charge

Batteries must be maintained on float charge and should be fully recharged within 24 hours of any discharge.

The recommended float charge voltage is 2.25Vpc at 77˚F. Floating the batteries above 2.25Vpc will lead to overcharging as well as a shorter service life. Floating the batteries under 2.25Vpc without a regular equalize charge will lead to reduced capacity, sulfation build-up and premature failure. For these reasons, we recommend 2.25Vpc @ 77°F, whenever possible.

The system float voltage should equal: (# of cells in system) x 2.25Vpc = System Float Voltage. Float voltage should not vary by more than +/-1%. Should the float voltage of any cell vary by +/-0.05Vpc apply an equalize charge and contact your sales office should this not correct the problem.

Float Charge Adjustment

The float charge voltage will need to be adjusted if the average operating temperature is above 86°F or below 50°F.

SBS does sell chargers that automatically compensate the float voltage with an increase or decrease in temperature; however, if you do not have temperature compensation on your charger you will have to make the following adjustments to assure you are not over or under charging the system: If the average battery temperature exceeds 86°F, the float charge voltage shall be reduced by (AT - 86) x .003Vpc (but not less than 2.18Vpc).If the average battery temperature is lower than 50˚F, the float voltage shall be increased by (50 - AT) x .003Vpc.

Example: AT= 92°F: (92-86) x .003 = reduce Vpc by .018. AT=the average operating temperature.
A 60 cell system with a standard float voltage of 135Vdc (2.25Vpc) should be floated at 133.92Vdc if the operating temperature is 92˚F. Deviations of individual cell voltages of +/-.05Vpc may be observed. However, the total voltage of the battery system shall be within the limits stated above.

Equalizing Charge (AKA Refreshing Charge or Boost Charge)

►**Note:** Because the permissible system voltage level may be exceeded when equalize charging at increased voltages, suitable measures should be taken to protect the load circuits (e.g. charging off-line).

When should an equalize charge be applied?

- **Quarterly**
- When individual cells fall below 2.22Vpc or when block voltage falls below 13.32Vdc (for 12V blocks) or 6.66Vdc (for 6V blocks).
- After a deep discharge, or after an inadequate recharging, an equalizing charge may be used to recharge the battery system quicker.

Charge at a voltage of 2.35Vpc for no more than 24 hours. Current should be limited to 20% of the amp hour rating of the battery.

The actual time needed to equalize depends on the initial state of charge of the battery system and the voltage and current applied. The fully charged condition has been achieved when, for a period of two hours, the cell voltages do not continue to increase and the charging current does not continue to decrease.

If the maximum temperature of 95°F is exceeded, charging must be terminated or continued at a reduced current or temporarily switched to float charging.

Upon completion of the equalize charge place the batteries back on float charge.

If there are still voltage discrepancies after an equalize charge is carried out contact SBS.

►**Note:** Leaving VRLA batteries on equalization charge for long periods of time may result in: voided warranty, seriously overcharging the battery causing the pressure relief vents to open, loss of electrolyte (dry out) and shortened system life.

Recharge

After a discharge, the battery can be recharged at the operating voltage (float voltage) or to reduce the charging time the recharging can be carried out per the equalizing charge instructions. The recharging times vary depending on the charging procedure and on the charging current available. Recharge 1.2 times the discharged capacity.

4.0 TEMPERATURE

Higher temperatures reduce the operational life. Lower temperatures reduce the available capacity.

The permissible operating temperature range is 5°F to 130°F however operating VRLA batteries above 95°F will void the warranty.

The recommended operating temperature range is 68°F to 77°F. This will maximize life and minimize maintenance. All technical data relates to a rated temperature of 77°F(25°C).

5.0 DISCHARGING – End of Discharge Voltage Limits

The battery must not be discharged more than the capacity specified in the performance data tables. Deeper discharges may damage the battery and shorten its operational life. A low voltage disconnect is recommended to prevent deep discharge.

As a general rule, the end of discharge voltage shall be limited to the values listed below:

Table 2 – Discharge Voltage

Discharge Time	End Voltage
5 min. < t < 59 min.	1.70Vpc
1 hr. < t < 8 hrs.	1.75Vpc
8 hr. < t < 24+ hrs.	1.80Vpc

Individual cell voltages may fall below end voltage per cell by not more than 0.2Vpc.

Discharged Cells

Batteries must not be left in a discharged condition. They must be immediately returned to recharge mode. Failure to observe these conditions may result in greatly reduced service life. See section 3.0 for charging instructions.

►**Note:** Each deep discharge is abusive and could affect the life expectancy of the battery.

6.0 ELECTROLYTE

The electrolyte is a diluted sulfuric acid. AGM type cells will have the electrolyte absorbed into the matting materials between the positive and negative plates. There is very little free electrolyte in the cells. GEL type cells will have the electrolyte suspended in a gel. VRLA batteries typically use an electrolyte with a specific gravity of 1.300-1.310.

7.0 SPECIAL APPLICATIONS

Whenever the batteries are to be used for special applications (non floating type applications) such as repeated cycling or under extreme ambient conditions, please contact your sales office. Different instructions may apply. In addition, the battery may have a shorter operational life.

8.0 MAINTENANCE & TESTING

Cleaning

Keep containers and lids dry and free from dust. Cleaning must be undertaken with a damp cotton cloth without man-made fibers or addition of cleaning agents. Do not use feather dusters or dry cloths. This could cause static discharge which can lead to an explosion hazard.

Capacity/Discharge Testing

Capacity tests should be carried out in accordance with IEEE-1188. Discharge tests should be performed between 65°F and 90°F.

Pretest requirements

- An equalize charge should be completed. No more than 24 hours at 2.35vpc is recommended by SBS.
- A float charge of no less than 72hours should follow the equalize charge up to the start of the test.

  All battery voltages should be within tolerances noted in charging section 3.0. If any batteries have a voltage outside of the allowable float charge range SBS should be contacted prior to the test starting.

Test length

SBS recommends discharge times of 1 to 8 hours to an end cell voltage of 1.75Vpc.

Discharge Rate

Performance data is available at www.sbsbattery.com or can be supplied by contacting SBS.

Information to Record Before and During Test

- Read and record the float voltages of the system AND each battery just before the start of the test (with charger on).
- Record the float voltage at the battery terminals just before the start of the test (with charger on).
- Record the float voltage of each cell/block just before the start of the test (with charger on).
- Record the ambient temperature as well as the batteries temperature at the negative terminal.
- Record the voltage of each cell once the charger is off prior to placing the load on the system.
- At regular time intervals during the test, measure Total Vdc, Amps DC and Individual cell voltages of all batteries / cells.
- As the test nears its end, it may be necessary to take readings more frequently to monitor cells that are approaching low voltage limits.

What to do if a Cells Voltage drops below the Specified End Cell Voltage Prematurely – Per IEEE1188

- If the specified end system voltage has not been reached **do not** interrupt the test unless an individual cell is approaching reversal of its polarity (0.0 volts).
- If one or more cells are approaching reverse polarity (0.0 volts) the test should be continued with the cell/unit bypassed where feasible. The time required to disconnect the cell, install the jumper, and restart the test shall not exceed 6 minutes. Complete the bypass away from the cell/unit to avoid arcing. The new minimum voltage should be determined based on the remaining cells.
  This "downtime" shall not be included in the test discharge period (i.e., the capacity determination shall be based on the actual test time). No more than one "downtime" period should be allowed when a battery is being tested. It is very important that the user work with the manufacturer or other experienced personnel to plan the course of action. The possibility of a weak cell(s) should be anticipated, and preparations should be made for bypassing the weak cell(s) with minimum hazard to personnel.

Temperatures effect on a Capacity/Discharge Test

If the operating temperature of the system is above or below 77°F a correction factor will need to be applied to either A) the test results or to B) the current applied to determine the true capacity of the system. **(Reference IEEE-1188-2005)**

A) Time Capacity Determination for Calculating System Capacity – *Recommended by SBS*

When using this method, no correction of any type is required prior to the performance of the test. The systems capacity is calculated after the completion of the test using the published performance data at 77°F. This method is recommended for test over 1 hour.

To calculate the % capacity of your system $C = \frac{Ta}{Ts \times Kt} \times 100$

C = % capacity at 77°F
Ta = the actual time (in minutes) of the test to specified end cell voltage
Ts = the rated time (in minutes) of the test to specified end cell voltage
Kt = the time correction factor in Table 3

Table 3 –Time Correction Factors

^{0}F	65	67	69	70	71	73	75	77	79	80	81	83	85	87	89	90
Kt	0.920	0.935	0.948	0.955	0.960	0.975	0.985	1.000	1.007	1.011	1.017	1.030	1.040	1.050	1.060	1.065

Example: An AGM-300 battery is rated to deliver 104Amps for 5 hours (300 minutes) to 1.75Vdc at 77. The system was 65°F, was discharged at 104Amps and the systems end cell voltage was reached at 4 hours and 25 minutes (265 minutes).

$C = \frac{265}{300 \times .92} \times 100$ = System has 96% Capacity

B) Rate Adjustment Capacity Determination

When using this method the published rating (current) for the selected test length is de-rated below 77°F and increased above 77°F to take into account the effects temperature has on a batteries performance.

To calculate the adjusted discharge current for test $A = \frac{Xt}{Kc}$

A = adjusted discharge current for test
Xt = the published rating (current) for time to specified end cell voltage at 77°F
Kc = the temperature correction factor in Table 4

Table 4 – Current Correction Factors

^{0}F	65	67	69	70	71	73	75	77	79	80	81	83	85	87	89	90
Kc	1.080	1.064	1.048	1.040	1.034	1.023	1.011	1.000	0.987	0.980	0.976	0.968	0.960	0.952	0.944	0.940

Example: An AGM-300 battery is rated to deliver 104amps for 5hours to 1.75Vdc at 77°F. The site temperature is 65°F prior to starting the test.

$A = \frac{104}{1.080} =$ 96.3Amps

The system should be discharged at 96.3Amps for 5hours to 1.75Vpc.

REQUIRED PERIODIC INSPECTION AND MAINTENANCE ACTIVITIES

Keep a logbook in which the measured values as well as power cuts, discharge tests, equalize chargesstorage times and general conditions can be noted. If a problem or warranty situation does come up this information is necessary in determining the course of action.

To obtain the full capacity and service life from your SBS stationary battery system, the performance of complete and timely periodic maintenance is essential. Temperature extremes, improper charging voltage and individual cell voltage imbalance are a few of the items which can have a negative effect on the system.

Routine inspection, charger/rectifier checks, and pilot cell checks should be performed monthly. More detailed inspection of the battery is required on a quarterly and annual schedule.

GENERAL BATTERY ROOM AND EQUIPMENT INSPECTION – perform the following checks whenever in the battery room:

- The battery room is clean, dry, and clear of debris and within a 68-77ºF temperature range.
- The battery room ventilation system is operating.
- Battery room and personal safety equipment is available and operational.
- Battery cleaning and acid neutralization supplies are available on site.
- Battery maintenance equipment and tools are available and operational.

MONTHLY CHARGER/RECTIFIER OUTPUT CHECKS – record in a log book the following:

- Charger rectifier output voltmeter reading: It should be the same value as that read with a calibrated voltmeter. It should equal 2.25 volt DC x number of cells. If a deviation in voltage greater than +/- 1% occurs, the charger must be adjusted or checked for proper operation. **Measure voltage at battery terminals.**

MONTHLY BATTERY SYSTEM CHECKS – record in a log book the following:

- Record the battery system float charging voltage: It should be equal to the number of cells multiplied by the recommended charging voltage per cell.
- Record each pilot cell charging voltage: The pilot cell charging voltage should be: 2.25V +/- .05V for 2V cells, 6.75V +/-1% for 6V blocks or 13.50V +/-1% for 12V blocks.
- Record the pilot cell negative post temperatures: The normal range is between 68-77ºF, and should have a variance no greater than 5ºF between individual cells.
- Visually inspect each cell noting any changes or abnormalities. If anything odd is noticed, record it and call sales office immediately to determine proper action. Changes you should look for may be, but are not limited to the following: discoloration, cracks, corrosion, and growth inside or outside of container. Any noticeable sign may be a sign of trouble.
- All cells and racks are clean, dry and free of any leaks, spilled electrolyte and corrosion.
- Record room temperature.

►**Note:** Individual cell charging voltage measurements are most accurate if 72 hours or more have elapsed since the system was discharged or equalized.

QUARTERLY BATTERY SYSTEM CHECKS – record in a log book the following:

In addition to the monthly inspection the following checks should be completed quarterly.

- Record the charging voltage of each cell or multi-cell block in the battery system.
- Record the Internal Resistance of each cell or multi-cell block.
- Record temperature of negative posts in the battery system.
- Review the general condition or change in condition of the cells, racks, cables and connectors.

ANNUAL BATTERY SYSTEM CHECKS – record in a log book the following:

In addition to the quarterly and monthly inspection checks, perform the following checks annually.

- Check torque of all connections (batteries and racks).

CAPACITY TESTING CHECKS – record in a log book the following:

In addition to all of the normal maintenance checks done on an Annual basis, a periodic capacity test of the battery system should be performed at least every (2) two years to verify the ability of the battery system to perform to specifications and then annually, every (1) year if the capacity of the system falls below 90%.

SUGGESTED REFERENCES

IEEE-1187-2002
Recommended Practice for Installation Design and Installation of Valve-Regulated Lead Acid Batteries for Stationary Applications

IEEE-1188-2005
Recommended Practice for Maintenance, Testing and Replacement of Valve-Regulated Lead Acid Batteries for Stationary Applications.

IEEE-1189-2007
Guide Selection of Valve-Regulated Lead Acid Batteries for Stationary Applications.

IEEE-1657-2009
Recommended Practice for Personnel Qualifications for Installation and Maintenance of Stationary Batteries.

If you have any questions or concerns contact SBS Stationary Technical Support.
E-mail: techsupport@sbsbattery.com
Phone: 1-800-554-2243

Early detection and corrections of problems can help prevent permanent damage to your battery system!

Corporate Office
N56 W16665 Ridgewood Dr.
Menomonee Falls, WI 53051
(800) 554-2243 • www.sbsbattery.com

BATTERY LOG BOOK

LOCATION / SITE NAME:	DATE:
DATE SYSTEM INSTALLED:	CHARGER P/N
BATTERY P/N	CHARGER VOLTAGE : _____Vdc
BATTERY VOLTAGE: # OF CELLS:	CHARGER CURRENT: _____Amps
AMBIENT ROOM TEMP:	

Cell#	Voltage	IR	Temp	Cell#	Voltage	IR	Temp	Cell#	Voltage	IR	Temp	Cell#	Voltage	IR	Temp	
1				16				31				46				
2				17				32				47				
3				18				33				48				
4				19				34				49				
5				20				35				50				
6				21				36				51				
7				22				37				52				
8				23				38				53				
9				24				39				54				
10				25				40				55				
11				26				41				56				
12				27				42				57				
13				28				43				58				
14				29				44				59				
15				30				45				60				

Battery System Condition:
Battery Connection / Cable Condition:
Any other Comments:

Contact SBS immediately if you find anything that doesn't look right or if you have any questions.

Storage Battery Systems - N56 W16665 Ridgewood Drive – Menomonee Falls, WI 53051
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